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Title: "A PROCESS AND A DEVICE FOR PREPARING BEVERAGES FROM SOLUBLE PRODUCTS"

TECHNICAL FIELD OF THE INVENTION

5 The present invention relates to a device and a method for the preparation of beverages from soluble products contained in disposable cartridges. In particular, the invention relates to the preparation of beverages carried out in machines provided with a collecting device designed to receive a cartridge of soluble product in order to produce hot beverages such as coffee, cappuccino, tea or the like.

10 BACKGROUND ART

In known machines, groups designed for the preparation and dispensing of beverages generally comprise a collecting device having a seat that receives a disposable cartridge.

15 Since the disposable cartridges are originally sealed to avoid spillage of the soluble product during handling, the collecting device is generally fitted with a piercing member that opens one or more outlet openings on a wall of the cartridge (for example, on the base wall of the same) in correspondence to a plurality of pre-established breaking lines.

20 Once the cartridge is inserted into the appropriate seat on the collecting device, hot water is admitted under pressure to the inside of the cartridge through one its entry ports in order to form a beverage consisting of a suspension or dispersion or solution in water of the soluble product, which beverage is delivered through an outlet opening or hole located on the cartridge.

25 A good dispensing group must guarantee complete and uniform solubilization or suspension/dispersion of the product in the fluid (usually water) inside the cartridge and good final appearance of the beverage; in the case of coffee and cappuccino good final appearance means being "creamy", i.e. having an appreciable amount of a layer of

enduring small-bubble froth. Obtaining such a result is complicated by the fact that the shape and dimensions of the cartridge are the same for all products dispensed, while the amount of soluble product in the cartridge varies dramatically from product to product (for example: 1.5 grams for espresso coffee and 15-16 grams of product for chocolate and cappuccino). This variation in amount can make difficult to obtain a homogeneously solubilized-suspended beverage. Another problem of known dispensing groups is guaranteeing thorough cleaning of the group; this requires avoiding the use of dispensing pipes and tubes with section less than 2 mm, because of the risk of formation of coatings and residues in the same.

In a previous patent application, still pending and not published, in the name of the same Applicant, it is suggested to provide a throttling arrangement along the dispensing course of the beverage, with the aim of improving the mixing of the soluble product with the water admitted to the cartridge and of creating a pressure gradient inside the cartridge so as to obtain a good quality beverage with attractive appearance on delivery. This has been achieved by means of a piercing member having a diameter greater than the diameter of the product outlet opening: the pressure of the water on arrival in the cartridge determines solubilization and delivery of the beverage.

However, it has been found that the beverage obtained is not always optimum, in particular with respect to the amount and duration of cream produced.

## SUMMARY OF THE INVENTION

The object of the present invention is therefore to produce a device and method for the preparation of beverages able to guarantee optimum and consistent results from the quality of beverage point of view.

This object is achieved by the present invention by means of a device for

the preparation of beverages according to Claim 1. Particular embodiments of the device according to the invention are reported in the dependent Claims from 2 to 15.

According to a first aspect of the present invention, the beverage preparation device comprises means of regulating the dispensing of the beverage in such way that the soluble product is delivered in suspension for at least 75% of the total dispensing time.

According to another aspect of the present invention, the means of regulation comprise one or more delivery ports or ducts between the piercing member and the cartridge outlet opening.

In a preferred embodiment, the delivery port has a substantially circular crown section, and the ratio  $R$  between the diameter of the outlet opening and the diameter of the section of engagement of the piercing member is  $1 < R \leq 1.067$ , preferably  $1 < R \leq 1.04$ , still more preferably  $1 < R \leq 1.02$  and still more preferably  $1 < R \leq 1.014$ . For example: fixing the diameter  $D2$  of the piercing member at 15 mm, gives the diameter  $D1$  of the outlet opening in the cartridge as  $15 < D1 \leq 16$  mm, more preferably  $15 < D1 \leq 15.6$  mm, still more preferably  $15 < D1 \leq 15.3$  mm, and still more preferably  $15 < D1 \leq 15.2$  mm.

In another possible embodiment, adoptable as alternative to or in combination with the previous one, the means of regulation comprise one or more stop elements for limiting the deformation of a portion of the cartridge wall in proximity of the outlet opening.

Such stop elements could comprise for example: one or more supports of the piercing member, or a annular member having diameter greater than the outlet opening.

In the latter case, the annular member has a surface portion tilted towards the piercing member and towards the base wall of the cartridge, with inclination between  $1^\circ$  and  $45^\circ$  with respect to a

horizontal plane supported on the annular member, more preferably with inclination between 15° and 38° or still more preferably equal to 30° with respect to a horizontal plane supported on the annular member.

According with a second aspect of the present invention, a method for preparation of beverages as specified in Claim 16 is provided for. Further favourable characteristics of the method according to the invention are reported in the dependent Claims from 17 to 30.

The dispensing device according to the invention has numerous advantages. The reduced diameter dispensing openings that are formed between cartridge and piercing member during the beverage dispensing phase constitute a temporary throttling, i.e. a throttling that is eliminated at each delivery when the cartridge is removed, and that is newly created at the following delivery when a new cartridge is inserted into the collecting-piercing device. Further advantages are the homogenous and uniform solubilization/dispersion/suspension of the product and the production of a beverage with optimum appearance.

#### BRIEF DESCRIPTION OF THE DRAWINGS

Further characteristics and advantages of the present invention will become clearer from the following description which is given by way of example and is not limiting, with reference to the attached schematic drawings, in which:

- Figure 1 is a perspective view of a cartridge which can be used on a dispensing device according to the present invention;
- Figure 2 is a section view of the cartridge of fig. 1;
- Figure 3 is a perspective view of a collecting-piercing device;
- Figure 4 is a section view of the collecting-piercing device of fig. 3 with a cartridge inserted and perforated;
- Figure 5 is a section view of a further type of collecting-piercing device supplied with a deformation control ring;

- Figure 6 is a plan view of the collecting-piercing device of fig. 5;
- Figures 7 and 8 are a plan view and an enlarged view of two possible embodiments of the product outlet opening of the cartridge;
- Figure 9 is a view similar to that of figure 5 of further means of controlling deformation.

#### MODE FOR CARRYING OUT THE INVENTION

With reference to figures 1-3, the dispensing device according to the invention comprises a disposable cartridge 1 and a collecting-piercing device 2. The cartridge 1 is equipped with an upper surface with an opening 4 encircled by a flange 3, and by a lower base wall 5 on which a breaking line 5a is cut so that it defines an outlet for the solubilized product. The upper opening 4 is closed in a known way by a cover (not shown) provided with one or more inlet holes for the water of infusion, solubilization or dispersion-suspension. In a known way, the breaking line 5a consists of a linear curved portion of the base wall having reduced thickness and such that it can be easily broken by the piercing cylinder 7 of the collecting device 2; the line 5a is interrupted in correspondence to a portion 6 that constitutes a hinge for portion 8 of the base wall (referred to as "cover") defined by the line 5a and preventing the separation of the same from the rest of base wall 5 after the cartridge has been engaged on the collecting-piercing device 2 (fig. 4).

In figure 4 a cartridge 1 is shown in dispensing position, i.e. in the position in which it has been engaged by cylinder 7, which has caused the opening of base wall 5 along the line 5a and the rotation of base portion 8 towards the inside of the cartridge, thus forming the corresponding opening. The soluble product to be delivered is outlined and indicated by 9.

According to the present invention the dimensions of the piercing cylinder 7 and of portion 8 of base wall 5 are such that when the

cartridge is inserted onto cylinder 7, before feeding hot water under pressure, there is at least one port or space 10 between the base wall 5 and piercing member 7 to allow the exit of the solubilized or dispersed or suspended product. The port 10 is preferably provided in the shape of a circular crown (fig. 7), i.e. a single port that extends substantially around the perimeter of the cylinder 7. However, other embodiments of the port are possible that allow for different shapes and/or the presence of more openings between base wall 5 and cylinder 7. By using an ellipsoidal line 5a it is possible to produce, for example, two or more openings: if the minor axis of the ellipse is equal or less than the diameter D2 of the cylinder 7 (fig. 8) two openings are obtained separated by two points of contact between the base opening and the cylinder 7, if the minor axis of the ellipse is longer than the diameter D2 a continuous non circular opening is obtained around the cylinder 7.

In general, the maximum difference between the line 5a which forms the edge of the opening on the base wall 5 and the wall of cylinder 7 is comprised in the interval between 0.4 and 1.5 mm and preferably 1.5 mm. In any case, the total area of opening is such as to permit the regulation of the delivery of the beverage so as to produce the simultaneous delivery of water and product for at least 75% of the water-dispensing time. This simultaneous dispensing can be checked visually by observing the colour of the liquid coming out from the cartridge outlet: if the liquid is little coloured or substantially uncoloured there is not simultaneous dispensing in the sense indicated above. In practice, it is found that the results are obtained also when the size of piercing and opening differ by very little (for example, when two circumferences are almost equal and differ by 0.01mm) as long as there are delivery ports 10, even if they are extremely small.

Therefore, an object of the invention is a soluble beverage dispensing

device of the type indicated above, in which the ratio between the area of piercing member 7 and the area defined by the breaking line 5a is comprised in the interval between 1.0 and 1.284, but excluding a ratio of 1.0, and with the maximum extent of the space between line 5a (edge  
5 of the opening on the base wall 5) and wall of piercing member 7 comprised in the interval between 0.4 mm and 1.5 mm. By area of piercing member 7 is intended the area of the section of piercing member 7 taken at the height of base wall 5 of cartridge 1 when this is housed in the collecting device 2.

10 In the following description, reference will be made to a preferred embodiment in which member 7 and the line 5a are both circular (fig. 7). In this embodiment, the port 10, i.e. the dispensing opening, is substantially crown-shaped in section and the ratio R between the diameter D1 of said delivery port 10 and the diameter D2 of piercing  
15 member 7 is comprised between 1.001 and 1.04, preferably between 1.001 and 1.02 and more preferably between 1.001 and 1.014.

As pointed out above, cartridge 1 is generally made of plastic material, for example ethylene or propylene homo- or co-polymer suitable for use with foodstuffs. A preferred material has crystallinity higher than 70% and  
20 such a percentage of amorphous polymer as to give visco-elastic deformation to the base wall of the cartridge during the feeding under pressure of hot water. The term "visco-elastic deformation" means that deformation of the material of the base wall, at least in an area around of the edge of the opening on base wall 5 along the line 5a, is reduced  
25 or quite eliminated either by the end of the dispensing or in one or more phases during the dispensing. In other words, during all the phase of dispensing of the beverage, the material of the base wall, at least in said surround of the outlet opening, opposes the deformation caused by the water or other liquid being fed under pressure into the cartridge; in this

way, the extent of the deformation and therefore of the dimensions of the delivery port 10 are controlled during the dispensing of the beverage. The material moulding techniques will be chosen so as to conserve as much as possible the percentage of amorphous polymer in the end product. Suitable materials are chosen from (co)polymers of ethylene and propylene, for example (co)polymers of propylene comprising one or more alpha-olefines having 2-10 Carbon atoms, for example ethylene, 1-butene, 1-pentene, 4-methyl-1-pentene, 1-hexene, 1-octene; propylene formulations obtained by sequential polymerization of propylene and its mixtures with ethylene and/or alpha-olefines. The (co)polymers generally have Melt Flow Index between 0.2 and 60 at 230°C/21.6 N.

However, cartridges can be used which undergo plastic deformation of the base wall following feeding under pressure of hot water. In this case the visco-elastic effect described above of opposition to the deformation by the material itself will not occur and "mechanical means" are used in order to limit the extent of the deformation of the base wall. Figures 5 and 6 show a preferred embodiment of such means, constituted by a ring 12 arranged concentrically with piercing cylinder 7 and distanced from it. Ring 12 is supported on three fins 11 and preferably has a surface portion 13 tilted towards cylinder 7, i.e. towards the inside of device 2, and towards the base wall. The inclination of the upper surface portion 13 is therefore comprised in the interval between 1° and 45°, preferably between 15° and 38° and more preferably 30 ° to the horizontal.

As an alternative to ring 12, radial fins 11a can be used (fig. 9) that extend to the height of surface 13 of ring 12 and that have a portion of their upper surface shaped in similar way to the slanted surface 13 of the ring and similarly distanced from member 7.



Therefore an object of the invention is a dispensing device of the type described above, in which there are provided means of controlling the deformation of the base wall of the cartridge of the distribution of the beverage. Such means are constituted by a polymer construction material of the cartridge that introduces substantially visco-elastic deformation and/or by mechanical means of support such as a ring or support fins of the base wall. In both cases the extent of the deformation angle of the material surrounding the edge 5a of the product delivery opening is maintained within an interval between 0° and 45°, preferably between 15° and 38° and more preferably around to the 30° during the dispensing of the beverage.

The invention will now be further described with reference to the following examples given purely by way of illustration.

Example.

Group 1. Ten (10) coffees were dispensed from a Tuttoespresso hot-beverage dispensing machine with a collecting device fitted with a piercing cylinder of diameter (D2) of 14.7 mm and diameter of the cartridge opening (D1) of 15 mm. The cartridge used is made of ethylene co-polymer with substantially visco-elastic deformation of the base wall.

Group 2. Another ten (10) coffees were dispensed with similar cartridges, but made of ethylene co-polymer with higher crystalline content and plastic deformation of the cartridge base wall. The collecting device has a support ring inclined at 30 degrees to the inside and base of the said device.

Group 3. For comparison ten (10) coffees were dispensed under the same conditions and from the same machine using traditional cartridges and collecting device.

The assessment was carried out by measuring the volume (cc) of cream

obtained. The results show an average of 12.8 cc of cream for each coffee dispensed in Group 1, an average of 9.6 cc of cream for the coffees dispensed in the Group 2 and an average of 6.8 cc of cream for each coffee dispensed in Group 3 (traditional).